Lokamanya Tilak and the Astronomical Dating of the Vedas

by

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The majority of Indians know Lokamanya Bal Gangadhar Tilak as a great national leader who laid the foundations of the freedom struggle against the mighty British Raj. Many people are aware of Tilak’s reforms of the Hindu calendar. Not so many know that he also wrote an arithmetic text which was once used commonly in schools, or are familiar with his erudite commentary of Gita, the Gitarahasya. But I suspect that very few know of Tilak’s attempts to date the Vedas by astronomical methods. It is this last achievement that I wish to highlight in this brief article.

Vedas are sometimes called ‘Apaurusheya’, a word implying that no human being authored them. They were passed on from generation to generation when the ancient Aryans crossed into India and made their home here. While one searches in vain for the originators of these literary masterpieces, one may validly ask as to when they were produced. For, the language used by any human civilization evolves with time and extracts from a piece of literature often give clues to the times when it was written.

Style of writing, construction of sentences, the words themselves and the many allusions in the literature are often used to date it. Western scholars in the last century and the early present century used such methods to fix the era when the Vedas were produced. Of course these estimates cannot be very precise, but for what they are worth, their conclusion seemed to be that the Vedas are about 3000–4000 years old.

Tilak challenged these estimates and in his learned monograph ‘The Orion’ he gave a novel method of estimating the antiquity of the Vedas. Tilak’s method made an ingenious use of an astronomical clock provided by the motion of the Earth round the Sun. To understand the principle of Tilak’s method let us first discuss this clock.
We know that the Earth possesses two main motions. It revolves round an axis through its centre once in 24 hours, the axis intersecting the Earth's surface at the two poles N and S. The equator is the great circle in the plane perpendicular to the polar axis. This plane intersects the celestial sphere in a great circle called the celestial equator.

The second motion possessed by the Earth is round the Sun. Viewed from the Earth, the Sun appears to go round the Earth. The Sun's orbit round the Earth is an ellipse whose plane intersects the celestial sphere in a great circle called the ecliptic. The Sun moves along the ecliptic in a clockwise fashion when viewed from south to north.

Thus we have two great circles on the celestial sphere one called the equator and the other ecliptic. The planes of the two circles are inclined at an angle of about 23½ degrees. The points of intersection of the two circles are called equinoxes and are denoted by γ for the spring equinox and Ω for the autumn equinox.

The points γ and Ω are also called the first points of Aries and Libra respectively. Their association with seasons is indicated by the adjectives 'spring' and 'autumn'. Indeed, we may assume that when the Sun is close to γ there is spring on the northern hemisphere while when the Sun is close to Ω there is autumn in that hemisphere.

In the ancient days the Sun's position on the ecliptic was determined in terms of the background of stars and constellations. Thus as the Sun moved along the ecliptic different constellations were projected against it. The night-time constellations lying at the antipode of the Sun were used as identifications of the time of the year. The months derived their names from these constellations. Thus Chaitra corresponds to Chitra, Vaishakh to Vishakha, Ashwin to Ashwini and so on. Note that as seen from the Earth these star groups did not change their directions; it was the Sun that appeared to move against their background. (These remarks are of course in relation to the Earth's annual orbit round the Sun; not its rotation about the polar axis).

1. *The celestial sphere is the sphere at infinity centred on the observer on which he sees all the astronomical objects projected.
We now consider the important astronomical observation that was used by Tilak in dating the Vedas.

When a top is set spinning on the ground its spin axis does not maintain a fixed direction in space. It precesses, that is, it describes a cone round a fixed direction. In the same way the Earth’s spin axis—the polar axis—does not maintain a fixed direction; it also precesses in space describing a cone round the fixed direction perpendicular to the ecliptic. There is one point of difference, however, between the spinning top and the spinning Earth. Whereas the spin axis of the top goes round the fixed direction in the same sense (clockwise or anticlockwise) as its spin the Earth’s spin axis precesses in the opposite sense to its spin. Looking from south to north, the Earth which rotates from west to east, spins in the clockwise sense. The spin axis will therefore precess in the anticlockwise sense when we look at it from south to north.

The result of such a precession is that the equinoxes $\gamma$ and $\omega$ move along the ecliptic in the anticlockwise direction when looked at from south to north. The time taken for the spin axis to describe one cone is about 25,800 years. Thus the equinoxes go round the ecliptic once in this period. Notice that this motion of $\gamma$ and $\omega$ along the ecliptic is opposite to the sense in which the Sun moves along it.

Suppose we now consider the spring season which is current when the Sun is at $\gamma$. Since $\gamma$ itself is moving along the ecliptic, the spring season will not occur every year at the same ‘time’. That is, the location of the Sun against the background of stars will be different from one spring to next. The effect is, of course hardly noticeable from year to year, but it will become appreciable over a span of several centuries. The seasons gradually move backwards, coming sooner and sooner every year with respect to months defined by groups of stars.

Tilak’s idea was to compare the seasons and months in the Vedic literature to investigate this relationship because of a statement in Gita ‘Amongst the months I am Margashirsha and among seasons I am spring’. What was the logic behind such a statement? To make sense we have to go far back into the past when the equinoxes were in different locations. If in the Vedic literature we find references

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1. In both cases the precession is due to an external torque caused by the gravitational field acting on the system.
to where (i.e., in what group of stars) the equinox \( \gamma \) was we can easily determine how long ago that epoch was. For, our present observations show that \( \gamma \) is located in the star group ‘Uttara-Bhadrapada’.

So much for the astronomical part of the argument. In his monograph ‘The Orion’, Tilak goes into several lines of reasoning to interpret Vedic allusions to seasons and months, displaying in this process the keenness of a Sherlock Holmes chasing elusive clues. Let us capture some of those arguments below.

First we have to note that in the ancient days the year began at the winter solstice, which in modern calendar falls on 22 December. If we consider the ecliptic as clock dial at which we are looking from south to north and assume that the point \( \gamma \) falls at the location of 3, then \( \Omega \) falls at 9 while the summer and winter solstices fall at 6 and 12 respectively. Thus the ancient year began when the Sun was at 12 and the spring season came when the Sun was at 3. So to decide where the point \( \gamma \) was in ancient days we have to decide when did the year begin in that era.

Tilak found in **Taittiriya Sanhita** a passage which states that the ‘Phalguni-purna-masa is the mouth of the year.’ There are other passages in five **Brahmanas** which also suggest that the Phalguni full moon coincided with the winter solstice and marked the beginning of the new year. Since on the full moon night the Sun is diametrically opposite to the Moon (with respect to the Earth) it follows that on the Phalguni full moon, the Moon being in the constellation of Phalguni, must also be near the summer solstice. Thus Tilak deduced that **Uttara Phalguni** was at summer solstice and hence the spring equinox was near the star group Orion (**Mrigashiras**).

At this stage Tilak sought corroborative evidence and found it in the word ‘Agrahayana’ meaning the ‘first in the year’. Did ‘Agrahayana’ mean the month of Margashirsha as many scholars had interpreted or did it mean the constellation of Mrigashiras? If the former interpretation is correct, Margashirsha must have been the first month of the year. Tilak, however, gave grammatical, etymological and literary arguments to show that the latter meaning was implied, not the former. Since the constellations were listed from the spring equinox, it followed that ‘the first in the year’, Orion, was at or near the spring equinox in those days.
Tilak therefore concluded that the most important period in the Aryan civilization was the so-called Orion period which occurred around 4000 B.C. to 2500 B.C. During this period the spring equinox shifted from the constellation of Ardra to Krittikas. This was the period during which Vedic Suktas were written and sung. During the latter part of this period, according to Tilak, the Aryans divided and went three ways, to Greece, Persia and India. This period was followed by the Krittika period which extended from 2500 B.C. to 1400 B.C. The latter part of this period is recorded in the Vedanga Jyotisha.

According to Tilak the Vedic period extended even further back to around 6000 B.C. There are references in the Vedas for commencing sacrifices at Aditi the presiding deity of Punarvasu. Tilak argued that this epoch corresponds to this spring equinox being at or near Punarvasu.

If Tilak's arguments are correct, the Vedas must be considerably older than the indications so far from other age determining criteria. Tilak's method itself cannot be faulted so far as its astronomical aspects are concerned. Its possible weakness lies in interpreting the Vedic statements which (to us) sound very cryptic. Nevertheless, no one who has read 'The Orion', can fail to be impressed by the deductive power of the author and the ingenious way he has used the astronomical clock to throw light on an important mystery.